Chp. 8 Closing Problems

Show all relevant work!

Some useful(?) formulas:

$C = 2\pi r$ $\quad A = \pi r^2$ $\quad SA = 4\pi r^2$ $\quad V = \frac{4}{3}\pi r^3$ $\quad \cosh^2 x - \sinh^2 x = 1$

Arclength: $\ell = \int_a^b \sqrt{1 + [f'(x)]^2}\,\mathrm{d}x$ and $\ell = \int_\alpha^\beta \sqrt{\left(\frac{\mathrm{d}x}{\mathrm{d}\theta}\right)^2 + \left(\frac{\mathrm{d}y}{\mathrm{d}\theta}\right)^2}\,\mathrm{d}\theta$ $\quad$ Area $= \frac{1}{2}\int_\alpha^\beta [f(\theta)]^2\,\mathrm{d}\theta$ $\quad \overline{x} = \frac{\int x\,\mathrm{d}m}{\int \mathrm{d}m}$

Don't Panic

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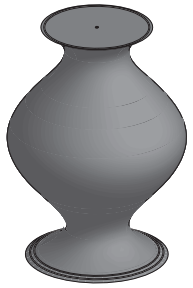
1. Zeke has a bank account that earns 4% annual interest, and he wants to have \$65,000 in the bank account in five years so that he can buy a brand new Porsche.

   (a) If the interest is compounded continuously and Zeke deposits a constant R dollars each year, determine R so that at the end of 5 years his account balance will be \$65,000.

   (b) Suppose instead that Zeke makes a single deposit and waits while it grows over the years. How much should he deposit now in order to have \$65,000 after 5 years?

2. A nuclear power plant produces strontium–90 at a rate of 3 kg/yr. How much of the strontium produced since 1971 (when the plant opened) is still around in 2010? (The half-life of strontium–90 is 28 years).

3. A block of maple is turned on a lathe to produce the solid sculpture shown on the right. Maple has a weight density of 0.2 pounds per cubic inch.
   The table below shows diameter measurements of the piece at height increments of 2 inches.

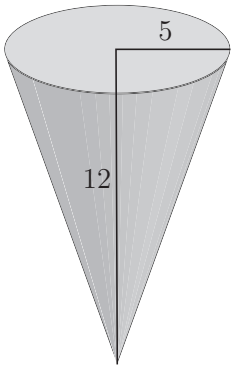


Height (in):	0	2	4	6	8	10
Diameter (in):	3.9	3.0	4.5	4.9	3.3	3.6

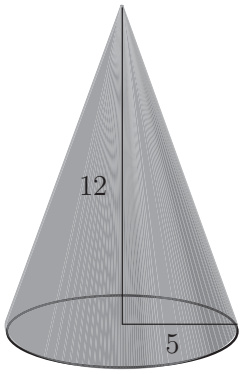
   (a) Use horizontal slices and the trapezoid method with increments of 2 inches to approximate the weight of the sculpture.

   (b) Use the trapezoid method with increments of 2 inches to help you determine the vertical center of mass of the sculpture (we will assume the horizontal center of mass (weight) lies along the axis of rotation).

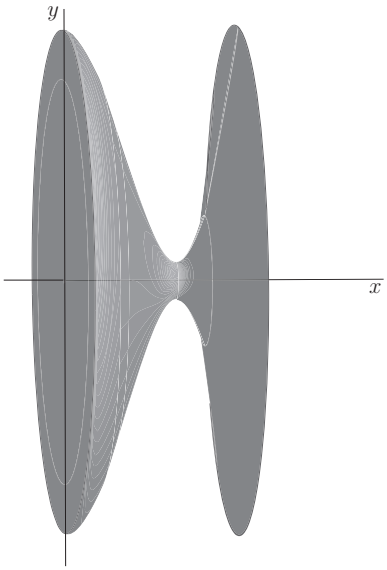
4. A conical tank of radius 5 feet and height 12 feet is filled with water. Find the work done by gravity in emptying the tank through the bottom. Assume the weight density of the water is 62.4 lbs/ft^3.



5. Repeat number (4) if the tank is turned upside down (but still drained by gravity down through the bottom).



6. Consider the region bounded by $y = x^3 - 3x^2 + 5$, the x-axis, the y-axis, and the line $x = 3$. Suppose we rotate this region about the x-axis. Assuming uniform mass density, δ kg/m^3, and all lengths in meters, determine the center of mass (along the axis of rotation) for this solid.



7. The following table gives the density D (in 10^{12} kg/(km)^3) of the Earth at a depth x km below the Earth's surface. The radius of the Earth is about 6370 km. Find an upper and lower estimate of the Earth's mass.

x (km)	0	1000	2000	2900	3000	4000	5000	6000	6370
D ($\times 10^{12}$ kg/(km)^3)	3.3	4.5	5.1	5.6	10.1	11.4	12.6	13.0	13.0

8. Find the arc length of the cardioid $r = 3 - 2\cos\theta$.